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Descripti n

The present invention relates to a process and an apparatus for use in the production of refuse derived fuel.

In order to produce from raw refuse a substance suitable for use as a fuel, it is necessary to separate and remove material which is incombustible or otherwise unsuitable for incorporation in the fuel. One way in which this can be done is by a so-called wet-pulping process as described for example in UK Patent Specification No. 1517687. Typically in such a process, after removal of heavy items made of metals, the refuse is converted to an aqueous slurry containing about 4—6% solids. The slurry is treated to extract its organic constituents, after which it needs to be dewatered by mechanical means to produce a combustible fraction containing up to about 50% solids by weight. Further mechanical dewatering is not really practicable, so that substantial amounts of thermal energy are consumed in driving off further moisture from the resulting fuel either prior to or during combustion. As described in UK Patent No. 1517687, the dewatered combustible fraction is dried in a rotary drier to a moisture content of 10 to 20% by weight and is then passed through a pellet mill. The energy consumed in the drying step has to be balanced against the energy available from the pelletised fuel produced, and this relatively high water content thus detracts from methods employing a wet pulping process. Disposal of the foul aqueous medium after use can also pose a considerable practical problem.

Another current process of producing refuse derived fuel operates by taking raw refuse, pulverising it and then screening it to remove fines and oversize material, the screened residue being passed to an air classifier or other dry separator where the light fraction, rich in paper and plastics, is separated. This light combustible refuse fraction is then passed to a desifying machine, either directly or via a secondary shredder, to produce pellets in the form of small dense cylinders or blocks having a calorific value equal to about half that of coal.

This conventional system, although quite adequate to produce combustible pellets has been found still to require some improvement in order to obtain consistent quality and quantity of pellets. In particular, it has been found that the ideal moisture content of the light fraction needs to be, in most cases, about 15 to 20% by weight whereas the combustible light material fed to the densifying machine normally has a higher moisture content, typically 35% and perhaps as much as 40% moisture by weight, although it should be noted that this means normally about half as much water per pound of combustible material as in the corresponding dewatered wet separated material.

Thus, because it has been separated by a "dry" method i.e. without the addition of water, the combustible light fraction contains much less water than is the case with a wet pulping process, and of course the problem of disposal of a foul aqueous medium is avoided. The same would be true of other dry methods of separation, such as for example a ballistic separator, and for this reason a dry method of separation is generally to be preferred.

In order to reduce the dry-separated combustible refuse material to the desired moisture content it is necessary to dry it and the methods of drying available, because of the very low bulk density of the light reaction (50 to 120 Kg per cubic metre) are either pneumatic or rotary, with the size, and therefore the cost of the dryers, being very high if they are adequately to deal with the very large volume of very low density light fraction to be processed.

The present invention is principally directed at providing a process and apparatus by which the very expensive large size drying apparatus can be reduced in size and simplified with substantial capital cost savings.

According to the invention there is provided a process for producing fuel from raw refuse material comprising the steps of pulverising and screening to remove fines and oversized materials, then subjecting the material to a dry separating step to separate therefrom, without the addition of water thereto, a light moist combustible fraction consisting mainly of paper and plastics and having a moisture content not greater than 40% by weight, and then treating the combustible fraction to form solid fuel pellets having a bulk density of between 350 and 850 Kgs per cubic metre, characterized in that the combustible fraction is partially compacted by a first densifying step to a bulk density of between 200 and 350 Kgs per cubic metre, is then dried by passing air therethrough to reduce the moisture content to a value between 10 and 20% by weight, and is then compacted by a second densifying step to the required bulk denisty to form solid fuel pellets.

The partial densifying step will preferably be such as to result in a partially compacted material having a bulk density of 310 to 330 Kgm^{-3}.

The drying step can be carried out in any suitable type of dryer, such as a rotary dryer, in which the material is tumbled within a rotating drum whilst a flow of warm air is passed therethrough. Other dryers suitable for particular circumstances include a vibratory fluid bed dryers, and air-ventilated drying towers (with or without additon of heat).

After the drying step, this material is in a condition in which biological deterioration is substantially reduced especially if the moisture content is reduced to around 14% or less and in this form it can be stored and used as a fuel.

The density of the solid fuel pellets resulting from the second densifying step is most usually 450 to 550 Kgm^{-3}. The higher the water content, the lower the density. The drier material is more difficult to press and hence more costly in terms of energy consumed and machine wear. Howeyer

this must be set against cheaper transport costs for the drier, hence denser, material.

A further broad aspect of the invention provides apparatus for carrying out the process of the invention, comprising a pulveriser and screen for pulverising and removing fines and oversized materials from raw refuse material, a separating device for separating from the material, by a dry separating step and without the addition of water, a light moist combustible fraction, a dryer for drying the light moist combustible fraction by passing air therethrough, and a second densifying machine operatively connected to receive dried material from the dryer to compact the dried material to form solid pellets therefrom, characterised by the inclusion of a first densifying machine operatively connected to receive material from the separating device by means of an outlet to compact the light moist combustible fraction to a density intermediate between that of the light moist combustible fraction and that of the solid pellets, the first densifying machine being operatively connected via an outlet to pass the thus compacted material to the dryer.

The benefits of the process and apparatus of the present invention derive from the fact that it has been found that by carrying out an initial densifying step with the light combustible refuse fraction which has too high a moisture content; and subsequently drying this partially compacted product, the drying action can take place in a dryer which is very much smaller than that which would be needed to treat the moist very light combustible reaction as initially separated. There is thus a consequent substantial saving in capital cost and outlay.

Furthermore, it has been found that despite the fact that the partially compacted product of the first densitfying step is far denser and in a more compact form than the dry-separated light fraction as initially separated, there is no deleterious effect as requiring a greater energy input for drying. This is despite the fact that one would expect a better heat transfer to obtain through drying air being able to pass through the separated light fraction as compared with not being able easily to pass through the interstices of a partially compacted material. In fact, in many cases, the energy input for drying the partially compacted material is less in total then the energy input needed to dry the light fraction prior to densification due to the smaller throughput of hot air required to carry off the moisture driven off. Conveniently the drying can be carried out in a rotary dryer enconomically to give the refuse material to be fed to the final densifying operation a moisture content of between 10% and 20%, normally between 15% and 20%, preferably about 17½% moisture content by weight.

Preferably, a shredder is provided for shredding the material fed to the first densifying step and also it is preferred that the first densifying machine is one in which pellets are formed, advantageously by forcing the material through the tapering holes in a dye screen.

According to a further advantageous feature of the invention, other combustible material is added to and mixed with the partially compacted combustible fraction of the refuse material between the first and the second densification steps.

Normally it is preferred that the other combustible material is added after the drying step.

The invention leads to particular advantages where the said other combustible material is in particulate form. However, in some cases there may be advantages in adding other combustible material in non-particulate form, such as tar or like substances, leading to a denser and more uniform product.

A very suitable example of the other combustible material in particulate form is coal dust, but also suitable are sawdust or other particulate combustible materials such as may result as waste from industrial processes. It has been found that particulate materials do not mix effectively with the light combustible fraction which has not been densified and is normally laminar in character. This is because the densities and other physical properties of the two materials are so different that their natural tendency is to separate when agitated. If mixing is attempted in the conventional process prior to the single densification step, it is found extremely difficult to ensure a homogeneous intermixing. The result is a heterogeneous pellet containing unevenly distributed agglomerates mainly of coal dust which destroy the cohesion of the individual pellets. On the other hand, fully densified pellets of dimensions suitable for fuel usage cannot be made to intermingle thoroughly with added particulate material without first disintegrating the pellets and there is a great tendency for pellets and added particulate material to segregate during handling. However, it is found that a coherent product results from mixing at the partially compacted stage.

Particularly in the case of coal dust, it is preferred to add the other combustible material after the drying step because the drying can drive off volatile constituents of the coal, and coal dust can also have a harmful effect on the operation of the drier, by penetrating bearings and causing excessive wear, or possibly causing explosions.

By contrast, the addition of coal dust is found to have a beneficial effect on the operation of a pelleting machine, in that the coal/refuse mixture tends to attain a semi-plastic state at a relatively lower temperature than would the refuse fractions alone, so that the mixture can be forced through the die screen of a pelleting machine more readily with consequently reduced wear on machinery and power consumption.

The coal-containing pellets themselves exhibit several advantages over those formed wholly of refuse material particularly if low volatile coals are used in the blend. Phenols and Cresols present in coal increase the biological stability of the product and the product is more like conventional fuels in appearance and combustion

characteristics, thus increasing its marketability. The pellets can also be handled and burnt more easily in conventional coal fired equipment.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:—

FIGURE 1 is a diagrammatic illustration of apparatus for feeding raw refuse to form fuel pellets therefrom which optionally include coal dust, utilising the process of the invention;

FIGURE 2 is a diagrammatic sectional view of a densifying machine for forming pellets from light combustible material; and

FIGURE 3 is a view of a detail of a screen which can be used in the machine of Figure 2.

Referring to Figure 1, raw refuse is fed at 1 into a pulveriser 2 which pulverises it into small elements, breaking down glass and other solids to relatively small sized pieces. From the pulveriser 2 the refuse passes to a screen 3 which removes fines at 6 and oversized materials at 4 with the residue passing at 5 to a dry separator in the form of air classifier 7 from which the heavier material leaves at 9 and the lighter material consisting mainly of paper and plastics at 8. The classifier can be of the type described in British Patent No. 1577325 which is in the form of a rotating frusto-conical vessel with its lower end tilted downwardly. The screened refuse is fed into the wide upper end of the rotating vessel while a spiral stream of air passes up the vessel from its narrow end in order gently to lift off and carry away the light paper and plastics material from the tumbling refuse.

The light combustible refuse leaving the classifier at 8 can optionally be passed through a shredder 10 before being passed to a densifying machine 11 which compresses the light refuse and compacts it to form separate intermediate pellets. These intermediate pellets are then passed to a rotary dryer 13 which reduces the material leaving the densifying machine 11, which commonly has a moisture content of 24% to 40% by weight, usually about 35%, to a preferred moisture content of about 17½% by weight, which is suitable for feeding into a further densifying machine in the form of a pellet press 14 from which the solid fuel pellets are received at 15. While the desired moisture content can be varied when fed to the final densifying machine depending upon the type of waste refuse being processed, perhaps within a range as large as 10% to 20%, in most cases a moisture content of between 15% and 20%, preferably about 17½%, is desirable.

If desired, coal dust or other particulate, combustible material can be added from a hopper 16 to the dried material, downstream of the shredder 10 if this device is present and nomally downstream of the dryer 13, as shown. The relative proportions of coal dust and dried refuse material are controlled by a metering device 17, and through mixing is effected in a mixer 18. Drying of the coal dust, even if moist, is unnecessary because its moisture will not be transferred to the dried material to any significant extent prior to pelleting in the pellet press 14. Preferably the coal fraction contains no particles which cannot pass a ¼ inch (6 mm) sieve. The proportion of coal can be any desired value from zero to an upper limit set by deterioration in the pellet quality. Pellets have been produced and found satisfactory which contain respectively 25% and 50% by weight of coal dust.

Figure 2 illustrates a typical pelleting machine which comprises an outer housing 22 having a pellet discharge outlet 24 and containing a rotating die screen 20. A vibrating feeder 26 is provided to feed material to be pelleted to the interior of the rotating die 20 in which are mounted a pair of pressure rollers 28 which are rotatable about fixed axes. As shown in Figure 3, the holes through the die screen 20 are tapered to be wider at their inner end than at their outer end and, although not shown in the drawings, the holes normally have a round cross-section to give cylindrical pellets. However, one commercially available ring roll press does have a cylindrical screen with holes shaped to produce pellets of rectangular cross-section. An adjustably positionable pellet knock-off blade 30 is provided to remove the material extruded from the exterior surface of the rotating die 20 giving pellets of the required length, which fall to leave through the outlet 24.

In order to use the densifying machine to make pellets the rotating die 20 is rotated clockwise as shown in Figure 2 past the pressure rollers 28, and material fed from the vibrating feeder 26 is held against the inner peripheral surface of the screen by centrifugal action and is forced by the die rotation into the pressure roller nip and is extruded through the tapered die holes with the extruded pellets being knocked off in convenient lengths by the adjustable pellet knock-off blade.

Alternative forms of densifying or pelleting machines may be used as convenient, for example, the feed material may be fed by an auger to a die screen to form the required pellets.

Claims

1. A process for producing fuel from raw refuse material comprising the steps of pulverising and screening to remove fines and oversized materials, then subjecting the material to a dry separating step to separate therefrom, without the addition of water thereto, a light moist combustible fraction consisting mainly of paper and plastics and having a moisture content not greater than 40% by weight, and then treating the combustible fraction to form solid fuel pellets having a bulk density of between 350 and 850 Kgs per cubic metre, characterized in that the combustible fraction is partially compacted by a first densifying step to a bulk density of between 200 and 350 Kgs per cubic metre, is then dried by passing air therethrough to reduce the moisture content to a value between 10 and 20% by weight, and is then compacted by a second densifying

step to the required bulk denisty to form solid fuel pellets.

2. A process according to Claim 1 wherein the dry separating step is carried out in an air classifier.

3. A process according to Claims 1 or 2 characterised in that the bulk density of the solid fuel pellets resulting from the second densifying step is from 450 to 550 Kgm^{-3}.

4. A process according to any one of Claims 1 to 3 characterised in that the densifying step results in a partially compacted material having a bulk density of from 310 to 330 Kgm^{-3}.

5. A process according to any one of claims 1 to 4 characterised in that the partially compacted material is dried in a rotary drier.

6. A process according to any one of Claims 1 to 5 characterised in that the moisture content of the light moist combustible fraction is reduced by the drying step to a value between 15 and 20% by weight.

7. A process according to Claim 6 characterised in that the said moisture content is reduced to a value of about 17½% by weight.

8. A process according to any one preceding claim characterised in that at least one of the densifying steps comprises compacting the material being processed by forcing it through a screen.

9. A process according to any one of Claims 1 to 8 characterised in that other combustible material is added to and mixed with the partially compacted combustible fraction of the refuse material between the first and second densification steps.

10. A process according to Claim 9 wherein the other combustible material is added after the drying step.

11. A process according to Claim 9 or 10 wherein the other combustible material is coal dust.

12. A process according to Claim 11 wherein the coal dust is screened to a size less than 6 mm prior to addition to the refuse material.

13. Apparatus for carrying out the process of any one of Claims 1 to 8 comprising a pulveriser (2) and screen (3) for pulverising and removing fines and oversized materials from raw refuse material, a separating device (7) for separating from the material, by a dry separating step and without the addition of water, a light moist combustible fraction, a dryer (13) for drying the light moist combustible fraction by passing air therethrough, and a second densifying machine (14) operatively connected to receive dried material from the dryer (13) to compact the dried material to form solid pellets therefrom, characterised by the inclusion of a first densifying machine (11) operatively connected to receive material from the separating device (7) by means of an outlet (8) to compact the light moist combustible fraction to a density intermediate between that of the light moist combustible fraction and that of the solid pellets, the first densifying machine (11) being operatively connected via an outlet to pass the thus compacted material to the dryer (13).

14. Apparatus according to Claim 13 characterised in that the drying machine (13) is a rotary drier.

15. Apparatus according to Claim 13 or 14 characterised in that at least one of the densifying machines comprises a die screen (20) and rollers (28) arranged to cause material to be compacted to be forced through the screen.

Patentansprüche

1. Verfahren zur Herstellung von Brennstoff aus Rohabfall, das die Schritte des Pulverisierens und Durchsiebens zur Entfernung von Feingut und Übermaßmaterialien, dann des Unterwerfens des Materials einem Trockenabscheideschritt zwecks Abtrennung einer leichten feuchten brennbaren Fraktion davon, ohne den Zusatz von Wasser dazu, die hauptsächlich aus Papier und Kunststoffen besteht und einen Feuchtegehalt von nicht mehr als 40 Gew.% hat, und dann der Behandlung der brennbaren Fraktion zur Bildung fester Brennstofftabletten mit einer Schüttdichte von zwischen 350 und 850 kg/m^3, dadurch gekennzeichnet, daß die brennbare Fraktion durch einen ersten Verdichtungsschritt zu einer Schüttdichte von zwischen 200 und 350 kg/m^3 teilwwise kompaktiert, dann mittels Durchleitens von Luft zur Verringerung des Feuchtegehalts auf einen Wert zwischen 10 und 20 Gew.% getrocknet und dann durch einen zweiten Verdichtungsschritt zur erforderlichen Schüttdichte zwecks Bildung fester Brennstofftabletten kompaktiert wird.

2. Verfahren nach Anspruch 1, wobei der Trockenabscheideschritt in einem Windsichter durchgeführt wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Schüttdichte der festen Brennstofftabletten, die sich aus dem zweiten Verdichtungsschritt ergibt, 450 bis 550 kg/m^3 ist.

4. Verfahren nach irgendeinem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der erste Verdichtungsschritt zu einem teilweise kompaktierten Material mit einer Schüttdichte von 310 bis 330 kg/m^3 führt.

5. Verfahren nach irgendeinem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß das teilweise kompaktierte Material in einem Trommeltrockner getrocknet wird.

6. Verfahren nach irgendeinem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der Feuchtegehalt der leichten feuchten brennbaren Fraktion durch den Trocknungsschritt auf einen Wert zwischen 15 und 20 Gew.% verringert wird.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß der Feuchtegehalt auf einen Wert von etwa 17½ Gew.% verringert wird.

8. Verfahren nach irgendeinem vorstehenden Anspruch, dadurch gekennzeichnet, daß wenigstens einer der Verdichtungsschritte die Kompaktierung des verarbeiteten Materials mittels dessen Pressens durch ein Sieb vorsieht.

9. Verfahren nach irgendeinem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß weiteres brennbares Material der teilweise kompaktierten

brennbaren Fraktion der Abfalls zwischen dem ersten und dem zweiten Verdichtungsschritt zugesetzt und damit vermischt wird.

10. Verfahren nach Anspruch 9, wobei das weitere brennbare Material nach dem Trocknungsschritt zugesetzt wird.

11. Verfahren nach Anspruch 9 oder 10, wobei das weitere brennbare Material Kohlenstaub ist.

12. Verfahren nach Anspruch 11, wobei der Kohlenstaub vor Zusatz zum Abfallmaterial auf eine Teilchengröße unter 6 mm gesiebt wird.

13. Vorrichtung zur Durchführung des Verfahrens nach irgendeinem der Ansprüche 1 bis 8, mit einem Mahlwerk (2) und Seib (3) zum Pulverisieren und Entfernen von Feingut und Übermaßmaterialien aus Rohabfallmaterial, einer Abscheideeinrichtung (7) zum Abtrennen einer leichten feuchten brennbaren Fraktion von dem Material durch einen Trockenabscheideschritt und ohne den Zusatz von Wasser, einem Trockner (13) zum Trocknen der leichten feuchten brennbaren Fraktion mittels Durchleitens von Luft, und einer betriebsmäßig angeschlossenen zweiten Verdichtungsmaschine zur Aufnahme getrockneten Materials vom Trockner (13) zwecks Kompaktierung des getrockneten Materials zur Bildung fester Tabletten daraus, gekennzeichnet durch die Einfügungs einer betriebsmäßig angeschlossenen ersten Verdichtungsmaschine (11) zur Aufnahme von Material aus der Abscheideeinrichtung (7) mittels eines Auslasses (8) zwecks Kompaktierung der leichten feuchten brennbaren Fraktion zu einer Zwischendichte zwischen der der leichten feuchten brennbaren Fraktion und der der festen Tabletten, wobei die erste Verdichtungsmaschine (11) betriebsmäßig über einen auslaß zum Leiten des so kompaktierten Materials zum Trockner (13) angeschlossen ist.

14. Vorrichtung nach Anspruch 13, dadurch gekennzeichnet, daß die Trocknermaschine (13) ein Trommeltrockner ist.

15. Vorrichtung nach Anspruch 13 oder 14, dadurch gekennzeichnet, daß wenigstens eine der Verdichtungsmachinen ein Preßsieb (20) und Walzen (28) aufweist, die zur Bewirkung des Pressens des zu kompaktierenden Materials durch das Sieb angeordnet sind.

Revendications

1. Procédé destiné à produire du combustible à partir de déchets, bruts, comprenant les étapes consistant à pulvériser et à passer au crible de façon à enlever les fines et matières de granulométrie excessive, puis à soumettre la matière à une étape de séparation à sec pour séparer de celle-ci, sans addition d'eau, une fraction combustible légère et humide constituée principalement de papier et de plastique et ayant une teneur en humidité ne dépassant pas 40% en poids, puis à traiter la fraction combustible pour former des pastilles combustibles solides ayant une densité en vrac située entre 350 et 850 kg/m^3, caractérisé en ce que la fraction combustible est partiellement compactée ou agglomérée à l'aide d'une première étape de densification pour obtenir une densité en vrac située entre 200 et 350 kg/m^3, puis elle est séchée par passage d'air à travers celle-ci réduire la teneur en humidité jusqu'à une valeur située entre 10 et 20% en poids, et elle est ensuite compactée ou agglomérée au moyen d'une seconde étape de densification pour obtenir la densité en vrac requise pour former des pastilles combustibles solides.

2. Procédé selon la revendication 1, dans lequel l'étape de séparation à sec est effectuée dans un classeur à air.

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que la densité en vrac des pastilles combustibles solides provenant de la seconde étape densification est de 450 à 550 kg/m^3.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que la première étape de densification donne une matière partiellement compactée ou agglomérée ayant une densité en vrac de 310 à 330 kg/m^3.

5. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé en ce que la matière partiellement compactée ou agglomérée est séchée dans un sécheur rotatif.

6. Procédé selon l'une quelconque des revendications 1 à 5, caractérisé en ce que la teneur en humidité de la fraction combustible légère humide est réduite par l'étape de séchage jusqu'à une valeur située entre 15 et 20% en poids.

7. Procédé selon la revendication 6, caractérisé en ce que la teneur en humidité est réduite à une valeur d'environ 17,5% en poids.

8. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce qu'au moins l'une des étapes de densification comprend l'opération de compactage ou d'agglomération de la matière en cours de traitement par forçage de celle-ci à travers un crible.

9. Procédé selon l'une quelconque des revendications 1 à 8, caractérisé en ce qu'une autre matière combustible est ajoutée à et mélangée avec la fraction combustible partiellement agglomérée des déchets entre les première et seconde étapes de densification.

10. Procédé selon la revendication 9, dans lequel l'autre matière combustible est ajoutée après l'étape de séchage.

11. Procédé selon la revendication 9 à 10, dans lequel l'autre matière combustible est de la poussière de charbon.

12. Procédé selon la revendication 11, dans lequel la poussière de charbon est passée au crible pour obtenir une granulométrie inférieure à 6 mm vant l'addition aux déchets.

13. Appareil destiné à la mise en oeuvre du procédé selon l'une quelconque des revendications 1 à 8, comprenant un pulvérisateur (2) et une crible (3) destinés à pulvériser à enlever les fines et les matières de granulométrie excessive des déchets bruts, un dispositif de séparation (7) destiné à séparer des déchets, à l'aide d'une étape de séparation à sec et sans l'addition d'eau, une fraction combustible légère et humide, un

sécheur (13) destiné à sécher la fraction combustible légère et humide en faisant passer de l'air à travers celle-ci, et une seconde machine de densification (14) raccordée opérationnellement de façon à recevoir la matière séchée provenant du sécheur (13) pour agglomérer ou compacter la matière séchée et former des pastilles solides à partir de celle-ci, caractérisé par l'inclusion d'une première machine de densification (11) raccordée opérationnellement pour recevoir la matière en provenant du dispositif de séparation (7) au moyen d'une sortie (8) pour compacter ou agglomèrer la fraction combustible légère et humide jusqu'à l'obtention d'une densité intermédiaire entre celle de la fraction combustible légère humide et celle des pastilles solides, la première machine de densification (11) étant raccordée de façon opérationnelle par l'intermédiaire d'une sortie pour amener la matière ainsi compactée ou agglomérée au sécheur (13).

14. Appareil selon la revendication 13, caractérisé en ce que la machine de séchage (13) est un sécheur rotatif.

15. Appareil selon les revendications 3 ou 14, caractérisé en ce qu'au moins l'une des machines de densification comprend un crible sous pression (20) et les rouleaux (28) agencés de façon à compacter la matière dont on veut forcer le passage à travers le crible.

Fig.1.

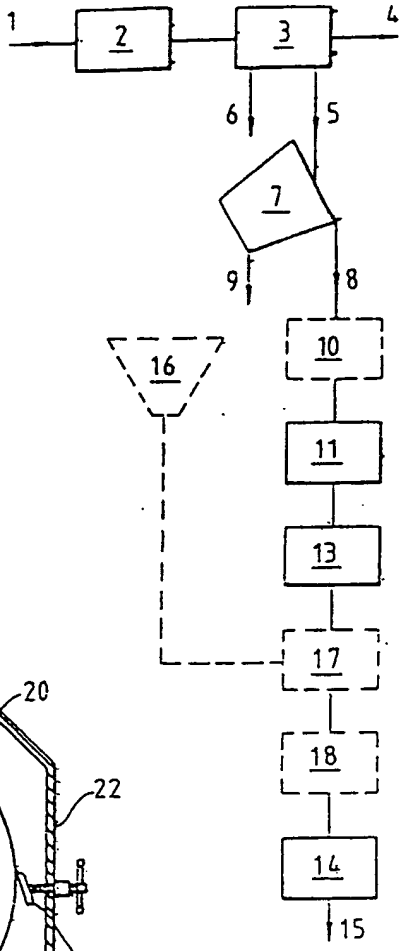
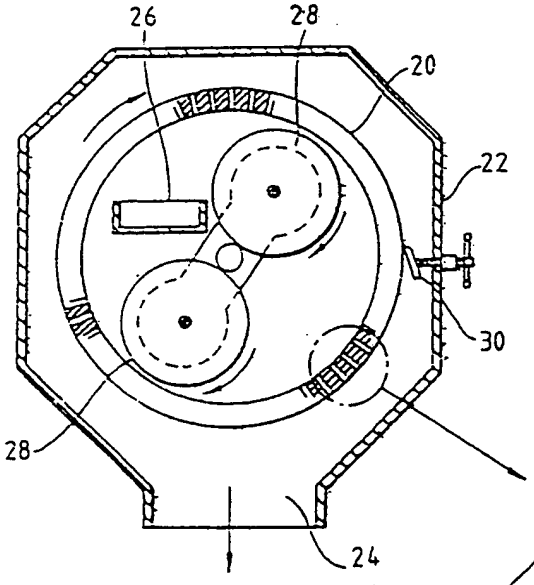


Fig.2.



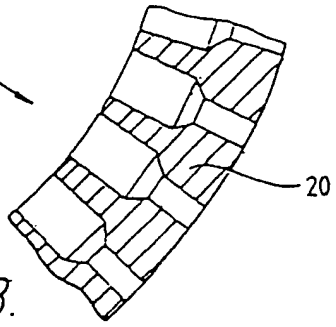


Fig.3.